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ABSTRACT

If, as research suggests, exposing children to two languages and two cultures provides a cognitive advantage, it could be assumed that a child exposed to two languages may be accelerated in a more advanced cognitive stage (as defined by Piaget) than a child exposed to only one language. This study sought to determine when Hispanic children from low socioeconomic backgrounds who received education in a maintenance bilingual program reached the concrete stage of development. Four groups of children (ages 6, 8, 9, and 10 years) completed three Piagetian tasks related to classification, conservation of mass, and conservation of area. Within the four groups there were 15 girls and 15 boys. The study found that the four groups possessed no cognitive advantage over monolingual students as indicated by their mean scores on the three tasks. (Contains 61 references.) (MDM)

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RATES OF COGNITIVE DEVELOPMENT AMONG BILINGUAL LATINO CHILDREN

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There is an ongoing debate concerning the intellectual functioning of children who are exposed to one or two languages. For example, several researchers believe that there is a detrimental effect on the intellectual development of children who speak two languages; some believe that such children experience "mental confusion" (Sear, 1923; Smith, 1923), others maintain that they are handicapped and retarded in the development of certain specific aptitudes (Altus, 1953) when compared to children who are exposed to only one language. Conversely, other investigators have found an enhanced development in children with two languages (Peal & Lambert, 1962; Fradd, 1982; McInnes, 1986; Bamford, 1991; Aikman, 1992) while others have found no significant differences between children with one or two languages (Anastasi & Cordova, 1978).

When is the appropriate time to introduce English? How should English be taught, and at what age? These and other questions are given new importance with the continuing influx into the public schools of children who speak a language other than English. One major issue revolves around the proper time to introduce the second language in the classroom. A number of studies support the conclusion that children five years of age and younger have few difficulties in learning a second language (Leopold, 1978; Yoshida, 1978). Lambert and Tucker (1972), Bamford and Porter (1991) have also suggested that increased exposure to a second language may facilitate competence in the native language among young children.

In California, for instance, the State Department of Education supports preschools in locations with a high enrollment of non-English-speaking children, where a prime function is to provide programs in which English can be acquired in natural linguistic settings. In such environments children become

proficient in both their native language and in English (Dahl, 1976; Wetzstein, 1978). Yet the State legislature has mandated first-language teaching in kindergarten (Dolson, 1991). This approach may not be the best and may sometimes be a cause of confusion. Little effort is being made to assist young children in becoming proficient in two languages and two cultures. Therefore, children will continue to maintain the first language as long as it is spoken in the home.

If exposing two languages and two cultures provides a cognitive advantage (Evans, 1953; Peal & Lambert, 1962; Fradd, 1982; McInnes, 1986; Twyford, 1987; Horgan, 1990; Bamford, 1991; Aikman, 1992), it could be assumed that a child exposed to two languages may be accelerated in a more advanced cognitive stage, as defined by Piaget (1976b), than a child exposed to one language. This delineation of Piagetian stages is best seen in the six-year-old child, during the transition from the pre-operational stage to the concrete operational stage (Pulaski, 1980), thereby providing a basis for a relatively clear measurement of the task of ascertaining any cognitive advantage which may be derived from exposure to two languages. Piaget's theory was meant to apply to all children. Therefore, utilizing Piagetian tasks to measure increases in performance is one way to study the problem. If educators remain alert to the cognitive variables relevant to a child's education, they can base instruction on children's individual potential.

Statement of the Problem

It has been concluded that industrialized middle-class children are able to conserve around the age of seven. The purpose of this study is to determine when Hispanic children from low socioeconomic backgrounds who received education in a maintenance bilingual program reach the concrete stage of development. This study explores the extent of measurable differences in performance on Piagetian conservation and classification tasks between six-, eight-, nine-, and ten-year-olds who have been

exposed to two languages.

Theoretical Background of the Problem

Studies built on the developmental theory of Jean Piaget have suggested that major progress in various aspects of language development occurs during the transitional stage between pre-operational and concrete operational thought (Francis, 1972). These studies build in the developmental theory of Jean Piaget. Language, as viewed by Piaget, is an instrument of thought organization. He stated:

> Language is not enough to explain thought, because the structures that characterize thought have their roots in action and in sensorimotor mechanisms that are deeper than linguistics. It is also evident that the more the structures of thought are refined, the more language is necessary for the achievement of this elaboration. (Piaget, 1968, p.89)

Piaget theorized that the developmental sequence through which a child progresses is universal, but that the age at which a child goes through the various stages may be dependent on the child's environmental background (Piaget, 1976b; Sigel, 1968).

Later studies have indicated that children in industrialized societies such as Japan (Iritani, 1967), Iran (Mohseni, 1976), Canada (Dodwell, 1961), England (Lovell & Ogilvie, 1960), and the United States (Elkind, 1961a, 1961b) progress through the Piagetian developmental sequence at a similar age, whereas children in industrially undeveloped regions progress at a later age (Otaala, 1973; Piaget, 1976b; Sigel, 1968). Some children, in fact, never reach the formal stage (Bruner, 1973; Otaala, 1973; Piaget, 1976b; Sigel, 1968). Other studies have indicated that an urban or rural environment may affect cognitive development (Greenfield, 1966) and that socioeconomic status may affect the rates of cognitive development (Almy, Chittenden, & Miller, 1966).

Two Language Exposure and Cognitive Development

Various researchers attempted to test the effect of exposure to two languages on intellectual functioning and reported different, often contradictory, results (Liedtke & Nelson, 1965). Several studies were listed and discussed by Jenson (1962). He pointed out that since the studies used different definitions of "bilingualism", had a small sample size, and showed methodological differences, the majority of the studies found disadvantages for children who are exposed to two languages.

Peal & Lambert (1962) reviewed studies on bilingualism dating as far back as 1920, and concluded that some studies showed bilingualism to have: (a) a detrimental effect on intelligence, as measured on standardized tests; (b) no significant effect on intellectual development; and © a positive effect on intellectual development. Peal and Lambert (1962) also felt that the contradictory results were produced by little control in the studies over internal and external validity factors such as socioeconomic status, sex, educational background, and age. In their own carefully controlled study, Peal and Lambert (1962) tested the hypothesis of no difference in intellectual development between children exposed to one language and children exposed to two languages, as measured by performance on standardized tests. They found that subjects with two languages (French and English) scored significantly higher on all verbal and nonverbal tests, and concluded that the bilingual subjects developed more independent abilities and skills and possessed a more diversified and flexible structure of intellect due to their exposure to and experiences of the second language.

Jacobs and Pierce (1966) tested the difference in divergent thinking processes between children with one language and children with two languages. They also found that bilingual children scored significantly higher on divergent thinking tests than children who were not bilingual. Many studies in this area have used standardized tests which have been criticized by Brody and Brody (1976). Often intelligence is defined as a factor called "G", which is nothing more than a statistically derived construct.

Intelligence Quotient tests do not test intellectual operation, but only test intellectual level (Brody & Brody, 1976). For example, wrong answers to questions on standardized tests give no information about the child's cognitive maturity and process.

Sullivan (1967) suggested that Piaget's theories may provide a more accurate assessment of intellectual capacities. Liedtke and Nelson (1966) used conservation tasks to assess intellectual capacities and to determine whether learning a second language at an early age has beneficial or detrimental effects on cognitive functioning among Canadian children. They concluded that the mean performance for children who speak two languages (French and English) is significantly higher than the mean performance for children who speak one language.

Using Piagetian tasks to measure the subjects' cognitive state, Smart (1969) performed research on the effect of parents who speak two languages (Spanish and English) on the cognitive development of Mexican-American children. She concluded:

> Where two languages were used in the intimacy of the family setting, the children of this study appeared to be developing a flexibility in their cognitive structures as evidenced by their groupings on the relational and thematic modes. (p.168)

Dahl (1976) used conservation tasks and the language synthesis tasks as measures of intellectual development in children who speak one and two languages. His longitudinal study revealed that the ability to speak two languages (English and Spanish) may accelerate the development of transitional mechanisms between the pre-operational and concrete stages.

Walden (1974) used classification skills as a measure of cognitive development for five, six, and seven-year-old children who speak one or two languages. She found that there were no significant differences in the mean gain among children who speak one or two languages (Spanish and English). The subjects of this study were multiethnic (white, black, Mexican-American, and Asian). Therefore, the

validity of the results may have been influenced by different cultural experiences, which are some of the confounding variables.

Wetzstein (1978), using classification tasks as a measure of intellectual development in Mexican-American children who speak one and two languages, concluded that dual language acquisition (Spanish and English) may have accelerated the conceptualization of representation in classification tasks. Fradd (1982), in her work on the influence that bilingualism has on cognitive development, proposes that bilinguals develop greater communication skills.

In studying first and second language acquisition, Dutcher (1982) concluded that many characteristics, including the cognitive development of the child, contribute to the determination of whether the child's first or second language is most effective in classroom instruction. Amadeo's (1983) examination of the effects of bilingualism on children, including the link between cognitive development and language acquisition, acknowledges the effect that both have on academic performance and self-concept. Bamford (1990) studied children placed in different types of educational settings. She found that metalinguistic abilities could be responsible for promoting the development of symbolic reasoning. Horgan (1994), using Piagetian tasks for measurement, found that a greater cognitive advantage may be derived from exposure to two languages (Japanese and English in this study) than from exposure to only one language.

In conclusion, many of the studies which utilized Piagetian tasks as a measure of intellectual development in comparing children who speak two languages to children who speak one language, showed that a cognitive advantage is derived from second-language acquisition.

METHOD

Experimental Control

Experimental control was achieved by reviewing the subjects' school records and using independent observations to ascertain the following:

1. Subjects were randomly selected from lower socioeconomic status groups.
2. Subjects had attended kindergarten.
3. Within the four groups, 15 girls and 15 boys were equally distributed.
4. Subjects were all participants in a Subtractive Bilingual Program.
5. Ethnic and cultural differences were minimized within each group (all children were Latinos who had been exposed to two languages).
6. All subjects were selected from low socioeconomic backgrounds.
7. Socioeconomic backgrounds were determined by income based on the School Lunch Program (Warner and Lunt, 1944).

Criterion Measures

Since classification and conservation parallel each other (Sigel & Hopper, 1968), performance on classification tasks should be a measure of conservation performance as well. The feasibility of using Piaget's approach in the study of children who are exposed to two languages has been established previously (Kessler, 1971; Tremaine, 1975).

Reliability of Criterion Measures

There is a major difficulty in using the results from Piagetian-type tests because there is not a workable statistical basis for estimating the reliability of scores. Furthermore, there are no standardized

procedures to guide the researcher in the selection of administration or scoring (Beard, 1969). Piaget (1976b) was aware of these issues, and employed a clinical method because he felt that standardizing procedures prevent the understanding of the child's problem-solving process (Sigel & Hopper, 1968). Piaget's method was applied in the present study.

Validity of Stages

Some claim that Piagetian tests contain cultural bias (Ashton, 1978). However, "Miller-Jones points out that Piaget's theory was acultural and was meant to apply to all children" (Bracey, 1989). Many validation studies of Piaget's work have been carried out in Western countries, especially in Canada, Britain, and the United States (Almy, 1970; Dodwell, 1961; Elkind, 1961; Lovell & Ogilvie, 1960) and are being conducted increasingly in non-Western countries in Africa and Asia (Iritani, 1967; Otaala, 1973). These studies have addressed the question of whether the stages of development in Swiss children (as studied by Piaget) are similar in other populations. In general, these replication studies have supported Piaget's findings on the sequence of development of the stages. One basic Piagetian contention is that in any one developmental stage, parallel invariant sequences exist for classification and conservation (Sigel & Hopper, 1968).

Validity of Fixed Age

Some cross-cultural studies have shown that the fixed age for each Piagetian stage varies depending on different cultural experience (Bruner, 1973; Goodnow, 1969; Greenfield, 1966; Mead, 1966; Price-Williams, 1961) and socioeconomic class (Almy et al., 1966; Mohseni, 1967). For example, children from a higher socioeconomic class or from an industrialized society exhibit age patterns similar to Piaget's subjects in Geneva, whereas children from nonindustrialized countries develop at later ages, although in the identical sequence. The studies cited illustrate that, despite variation in methodology and in the cultural settings of children, there is considerable consistency in findings that support certain

features of Piaget's theory. Piaget (1969, 1976a) did acknowledge the significance of environment as a stimulant in determining the age at which different children reach the stages:

> In some social environments stages are accelerated, whereas in others they are more or less systematically retarded. This differential development shows that stages are not purely a question of the maturation of the nervous system but they are dependent upon interactions with the social environment and with experience in general. The order, however, remains constant. (Piaget, 1969, p.7)

Piagetian Tasks

The three Piagetian tasks used in this study relate to Classification, Conservation of Mass and Conservation of Area. The tasks and the scoring method are described as follows:

Classification

The purpose of the first task was to discover what stage a child is in with respect to classification. The task has two parts. The first is spontaneous classification, which may result in the formation of graphic collections (Stage I), nongraphic collections (Stage II), and collections based on hierarchical systems of inclusion (Stage III). The second part contains a series of questions to discover whether the child is able to coordinate extension, in other words to define the members of a given class, and to coordinate intension, that is to define properties common to all members of that class (Piaget & Inhelder, 1964).

Piaget (1969) stated that logical operation in classification is closely aligned with certain actions which are quite elementary: putting things in piles, separating piles into lots, making alignments, and so forth. The development is continuous as a child interacts with his environment. Class inclusion operations relate to the child's ability to manipulate part-whole relationships within a set of categories.

In this experiment, 20 colored pictures were used: 4 pictures represented assorted colored objects

(a cluster of cherries, a chair, a dog, and a bicycle), and 16 pictures represented flowers; 8 of the flowers were roses (4 red), and the other 8 flowers were of different colors. The subject was asked to group pictures "that go together", and after completing this task, was asked to explain the basis for the groupings. The experimenter asked an inclusion question such as "Are there more flowers or roses?"

Scoring

Scoring was by stages and was designed to trace the continuous development, first of graphic, and then of nongraphic collections which finally lead to inclusion.

Stage I

The child matches a chain of similarities found successively in time with a spatial succession of elements. The child simply juxtaposes one element to the next, and takes each step as he comes to it, forgetting what went before and not foreseeing what must follow. For example, if a collection is comprised of red roses, different colored roses, different colored flowers, and other objects, a child may put all the red roses together, then a red cherry , a red car, red flowers, and so on. Or, if a child in this stage were asked and inclusion question such as "Are there more red roses or roses?" he would answer that there are more red roses.

Stage II

The child's collections are no longer graphic, and objects are assigned to one collection or another on the basis of similarity alone. Nevertheless, several collections are simply juxtaposed instead of being used as the basis of a hierarchical class structure. For example, unlike the Stage I child, the child in Stage II may group all the red roses, all the yellow flowers (including the yellow roses), all the similar-shaped flowers, and so on. Or, a child in this stage might respond to an inclusion question such as "Are there more red roses or roses?" by attempting to count the roses, answering that there is an equal amount.

Stage III

The child can classify the elements based on the hierarchical system of inclusion, and can

coordinate intension and extension. For example, the child might form separate groups comprised of all the red roses, all the different colored flowers, cherries (belonging to the group of flowers and the group of living things), a dog (belonging to living things), and a chair and a car (belonging to the group of nonliving things). The child understands the "all" and "some" relationships, such as the presence of more flowers than roses, or that there are more roses than red roses.

Conservation of Mass

The purpose of the second task is to discover what stage a child is in with respect to conservation. The task is concerned with the conservation of mass, in this case an amount of clay, and tests the child's ability to understand that certain properties of objects remain invariant in the face of external transformation. Smart (1970) described this ability as follows:

> Piaget considers the ability to "conserve" as a prerequisite to the development of logical and systematic thought. He defines the term conservation as the ability of children to recognize the equality or invariance of objects even if altered in shape, size, or position. Prior to acquiring this ability, children's capacities for viewing things in their true relations are limited. They believe with their eyes rather than their minds. As they acquire the form of reversible operations in the mind they are less dependent upon their visual perceptions. (Smart, Memorandum, 1970)

In this experiment, three transformations were made using clay. Equivalence was first established by forming two identical balls of clay which the subject would agree contained the same amount of clay. Then one of the two balls of clay was rolled into a sausage shape, and finally was divided into pieces. After each transformation the child was asked such questions as "Is there still the same amount?" Also, the child was asked for an explanation to determine conservation.

Scoring

Scoring was by stages and was designed to trace continuous development, first of perceptual, then of intuitive acquisitions which finally lead to conservation.

Stage I

The child's explanations are based directly on the physical attributes which can be perceived visually. For example, as soon as the child sees the ball-shaped clay changed into a long sausage shape, he believes that a long sausage shape has more clay because it is long.

Stage II

The child attempts to coordinate the influence of perceptual illusions, transforming them into true, operational relations; consequently, he vacillates from one response to another. One moment the subject may have an idea of conservation; in the next moment, he may lose the idea if the situation is slightly changed. For example, the child may explain that a sausage shape of clay has the same amount of clay as a ball shape, but if the shape changes into a hamburger shape or is broken into pieces, he will change his mind.

Stage III

The child is consistently able to explain that the quantities of clay are conserved, and gives an explanation such as, "You did not add any," or, "If you roll it back into a ball, then it will be the same."

Conservation of Area

The purpose of the third task is to discover what stage a child is in with respect to conservation. The task is concerned with the conservation of area and tests the child's ability to understand that if two equal parts are taken from two equal wholes, remainders will also be equal, despite the rearrangement of the parts. The concept of this task is similar to that of the second task, conservation of mass.

In this experiment the child was shown two identical rectangular sheets of green cardboard and was told that they represented two farmlands. The experimenter put a tiny plastic cow on each sheet at

the same time, telling the child that the cow had that amount of grass to eat. Once the child recognized that the two fields were exactly the same, he was told that one of the farmers had decided to build a house on his farm. The experimenter then put a wooden block on one of the cardboards. Fifteen wooden blocks of identical size were added one at a time to each "farm" but arranged unequally on the cardboards to give the illusion of different areas of "grass" left for the cows to eat. On one sheet the blocks were grouped together so that they touched. If, after each block addition, the child responded that the two cows did not have the same green areas, the experimenter would gradually move the spaced houses closer together. After each rearrangement, the question was repeated.

Scoring

Scoring was by stages, and was designed to trace the continuous development, first of perceptual, then of intuitive acquisitions which finally lead to conservation.

Stage I

The child's explanations are based directly on the physical attributes which can be perceived visually. The child refuses to admit that remaining areas are equal, often after the addition of the very first pair of houses. For example, the child may say, "This one has a lot of grass because the houses are together, and this one has a little grass because the houses are spread out".

Stage II

The child's explanations vacillate between perceptual appearances and reality. For example, the child attempts to count the blocks, or to move the houses to look the same in both fields. Or, the subject may respond up to a certain number of houses by admitting that the cows have the same green areas; but beyond that number, the perceptual configurations may appear too different for the subject to believe that they are equal in area.

Stage III

The child is able to explain immediately, or almost immediately, and consistently that the remaining

fields are equal. For example, the child may say, "One side looks as though it has a larger space because you put them close together, but these houses are the same size and the same number, so both cows have the same space.

Scoring Procedure

The scoring procedure was similar to that used by Piaget (1969). The child's cognitive stage was determined by his performance on the various tasks. Each task was divided into subtasks, and each subtask was used to confirm the accuracy of scoring the child's performance on the overall task.

If a subject was classified as Stage I, he received a score of 1; if a subject was classified as Stage II, he received a score of 2; and if a subject was classified as Stage III, he received a score of 3. There was a possible score of 3 points for each of the three tasks, and a possible total score of 9.

Test Administration Procedure

All testing was conducted individually by the investigator. In all the tasks, the investigator made certain that subjects understood the vocabulary that was used for testing. The investigator noted with care the type of reasoning used by the subjects, for Piaget considered the process of reasoning to be far more important than the objective correct answer (Piaget, 1980).

The order of presentation of tasks was classification, conservation of mass, and conservation of area. It is not possible at this time to determine what the effects of the order of presentation might be; these effects can only be established when different orders have been tried. The present order for the conservation items was suggested by Almy et al.'s (1966) study, which indicated that there was no significant difference in the number of children "conserving" in the various presentations.

Research Design

The research was designed to analyze statistically the measurements of the four groups. The hypotheses concerning the mean differences between the groups on each task (classification, conservation of mass, and conservation of area) were tested and used as a basis for making inferences. One-way analysis of variance (ANOVA) and post hoc multiple comparison (Newman-Keul method) were used, as described by Hinkle, Wiersma, and Jurs (1979).

The first method, one-way analysis of variance, was used to see if there were any mean differences among the four groups. The F test was performed as the underlying distribution.

When the first null hypothesis was rejected, a second method of analyzing post hoc multiple comparison was used (Newman-Keul method) to determine which groups differed. The studentized Q-test formula was used as the underlying distribution to control the experimental error rate for the set of all possible comparisons.

RESULTS

ANOVA showed that there were no significant differences among the means of all four groups in all three tasks ($p<.05$):

Classification	$F = 2.45\ (3, 116)$
Conservation of Mass	$F = 2.38\ (3, 116)$
Conservation of Area	$F = 0.21\ (3, 116)$

The findings of the post hoc multiple comparison for performance levels on the three Piagetian tasks (classification, conservation of mass, and conservation of area) were as follows:

	Classification	**Conservation/Mass**	**Conservation/Area**
6 Years Old	$N = 30$	$N = 30$	$N = 30$
	$EX = 34$	$EX = 37$	$EX = 33$
	$X = 1.13$	$X = 1.23$	$X = 1.1$
	$EX^2 = 42$	$EX^2 = 53$	$EX^2 = 39$
	$S^2 = 0.12$	$S^2 = 0.26$	$S^2 = 0.09$
	$S = 0.35$	$S = 0.51$	$S = 0.3$

8 Years Old	N = 30	N = 30	N = 30
	EX = 42	EX = 31	EX = 33
	X = 1.4	X = 1.03	X = 1.1
	$EX^2 = 66$	$EX^2 = 33$	$EX^2 = 39$
	$S^2 = 0.25$	$S^2 = 0.03$	$S^2 = 0.09$
	S = 0.5	S = 0.19	S = 0.3
9 Years Old	N = 30	N = 30	N = 30
	EX = 43	EX = 35	EX = 35
	X = 1.43	X = 1.17	X = 1.17
	$EX^2 = 69$	$EX^2 = 47$	$EX^2 = 47$
	$S^2 = 0.26$	$S^2 = 0.21$	$S^2 = 0.21$
	S = 0.51	S = 0.46	S = 0.46
10 Years Old	N = 30	N = 30	N = 30
	EX = 41	EX = 42	EX = 34
	X = 1.37	X = 1.4	X = 1.13
	$EX^2 = 63$	$EX^2 = 78$	$EX^2 = 42$
	$S^2 = 0.24$	$S^2 = 0.66$	$S^2 = 0.12$
	S = 0.48	S = 0.81	S = 0.34

INTERPRETATION OF FINDINGS

The data clearly shows that the four groups of subjects (Ages 6, 8, 9, and 10) which have been exposed to two languages possess no cognitive advantage as indicated by their mean scores on three Piagetian tasks. A graphic interpretation is presented in Table 1.

INSERT TABLE 1.

Piaget stated that his stages of development are invariant and sequential. One reason for the above results might be that these children of low socio-economic status came to kindergarten in the sensory motor or early pre-operational stage of development and received bilingual education which was too abstract for them.

RECOMMENDATIONS

The results of this study leave some puzzling questions with respect to the effect of second

language introduction on cognitive development. Piaget stated that his stages (sensori-motor, pre-operational, concrete operational and formal) are both invariant and sequential. Given this, it may be that the bilingual instruction the children are receiving is not developmentally appropriate (e.g. It is too abstract or does not match their cognitive stage).

In addition, since all of the children studied had been educated in subtractive bilingual education programs, the results might support earlier findings which indicated that additive bilingual education was a more effective approach (Peal & Lambert, 1962; Bialystok, 1992; Cummins, 1992; Horgan, 1994). The outcome might be different if children are exposed to additive bilingual education and if both languages are supported academically and emotionally by both the immediate community and society at large (Malakoff & Hakuta, 1992). A negative perception of the Spanish language in the community might affect children's interest, performance, and cognitive development.

The primary importance of this study to educators is that it raises serious questions about current bilingual teaching methodology. Clearly there is a need for further research in order to develop a more positive educational experience for bilingual Latino children.

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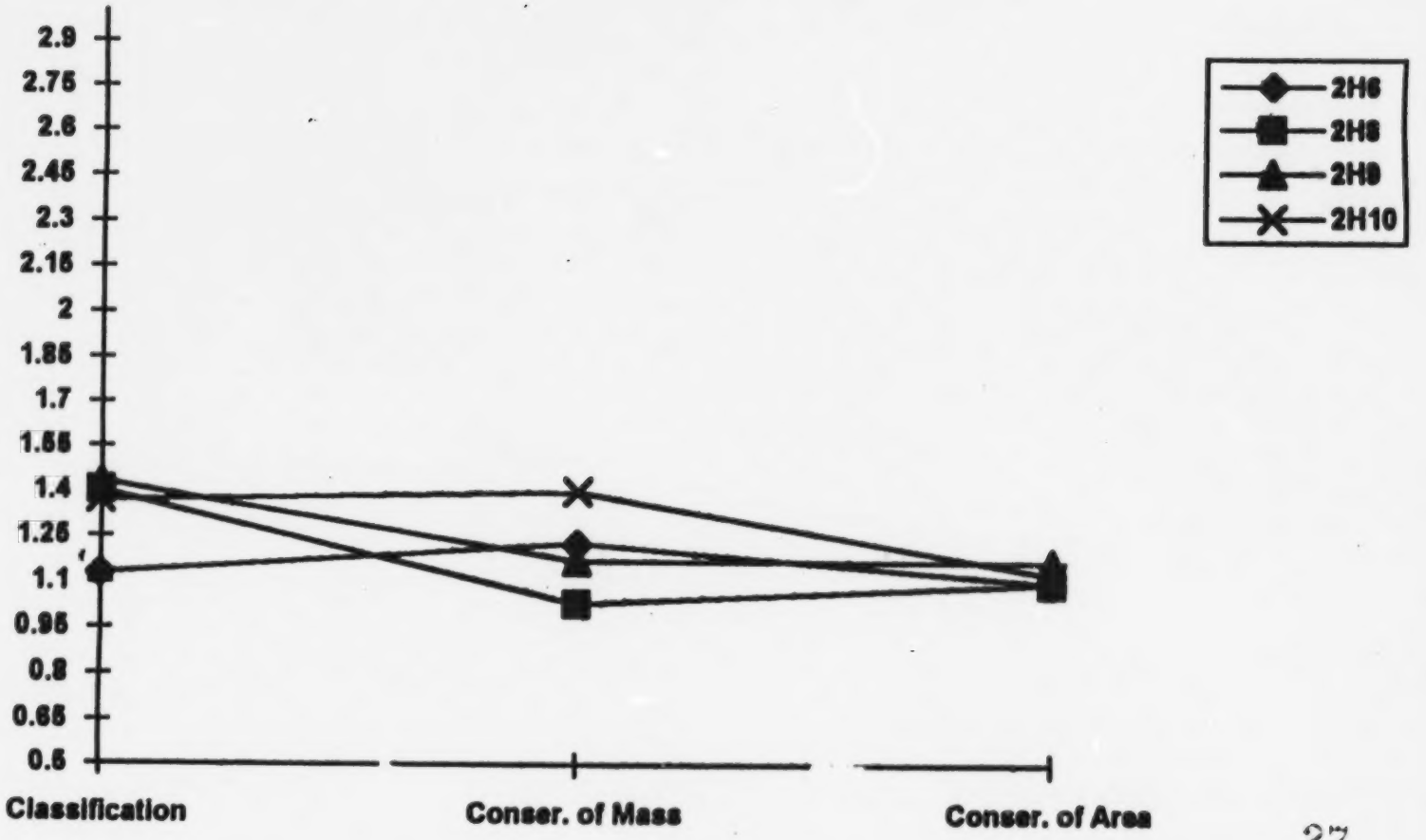
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0.95
0.8
0.65
0.5
Classification
Conser. of Mass
Conser. of Area
2H6
2H8
2H9
2H10